



# The role of food packaging on children's diet: Insights for the design of comprehensive regulations to encourage healthier eating habits in childhood and beyond

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## ABSTRACT

Food packaging design has become a key component of the marketing mix of companies to ensure the long-term success of their products, and to convey information that set apart their products from competitors. The aim of this review is to critically discuss the role of food packaging on children's diet. Food package design plays a key role in attracting children and parents' attention, shaping product associations, and influencing their purchase decisions. Packaging elements attracting children's attention and misleading health-related visual and textual cues may encourage children and their parents to choose energy-dense food products with excessive content of sugar, fat, and sodium. Results from this review suggest that comprehensive packaging regulations are necessary to protect children's health and encourage healthier eating habits from early years. Such regulations should go beyond products targeted at children, making informed decisions easier to encourage healthier choices, and including restrictions on the use of health-related cues on all products, as they ultimately influence the diet and the food available in the household.

## 1. Introduction

Unhealthy diets are a major burden of disease among children, impeding optimal growth and development (Kupka, Siekmans, & Beal, 2020). Globally, children's diets are far from optimal as they consume an excessive quantity of products high in sugar, fat and sodium and an insufficient quantity of fruits and vegetables (UNICEF, 2019). Although children's diets are the result of complex interaction of several factors, the role of food environment is increasingly recognized (Downs and Demmler, 2020).

The food environment can be regarded as the physical, socio-cultural, economic, and political context by which consumers interact with food systems to acquire and ultimately consume foods (Downs et al., 2020). Retail and commercial markets are a key part of the external food environment, as they are the place where people decide what and how much to buy (UNICEF and GAIN, 2019). The characteristics of this environment influence food consumption by shaping the

availability, affordability, convenience, and desirability of foods (UNICEF and GAIN, 2019; Herforth and Ahmed, 2015).

The retail sector has largely changed in the last few decades, evolving from small local shops and open markets to supermarkets (Stanton, 2015). In most countries, supermarkets have become the most important environment where consumers make their food purchase decisions (Popkin and Reardon, 2018; Stanton, 2015). Within the retail environment, multiple strategies are used to influence consumer food choices, including placement, pricing, promotions and packaging (UNICEF Regional Office for Latin America and the Caribbean, 2019).

Food packages have become ubiquitous and an inexorable part of the modern food environment. Rapid industrialization, urbanization and population growth led to the development of packaged foods to ensure safety and efficient distribution (Hine, 1995). The role of food packaging has largely evolved throughout history, exceeding its basic functions related to containment, protection and convenience (Pal et al., 2019). Packaging has become a key component of the marketing mix of food

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companies, who invest large amounts of money in package design to ensure the long-term success of products (Spence, 2016).

In particular, food packaging has received increasing attention in the context of children's eating patterns as it has become a key component of the strategies of the food industry to target products at children (Hawkes, 2010). Products targeted at children are a highly profitable market segment for the food industry. The market of child-oriented food and beverages worldwide is expected to reach 146.7 billion US dollars worldwide by the year 2025, growing at an annual rate of 5% (ReportLinker, 2020). From a nutritional point of view, most products targeted at children are not adequate for them as they usually contain high energy density and an excessive content of added sugar and fat (Elliott, 2019; Elliott and Truman, 2020; Giménez et al., 2017; Moore et al., 2020; Rito et al., 2019). Children are driven to unhealthy products by playful designs, indicating that the food industry needs better regulatory guidance to design packs that can help parents and encourage healthy eating habits for children (Abrams et al., 2015).

In this context, the aim of this review is to critically discuss the role of food packaging on children's diet. Results are expected to provide insights for the design of packaging regulations that should be implemented as part of a set of multifaceted strategies to encourage healthier eating habits among children.

## 2. A logic model for the effect of food packaging on children's diet

The effect of food packaging on children's diet can be attributed to its influence on the foods parents choose for their children, as well as on the foods children actively choose. In this sense, children can be regarded as primary consumers when they spend their own savings and allowances, as well as secondary consumers through "pester power" (i.e., their attempts to influence parental foods choices, also known as "nag factor") (Nicholls and Cullen, 2004). The influence of food packaging on school-aged children's decisions as primary consumers is expected to be particularly relevant at school canteens or cafeterias, as they are usually more autonomous from their parents.

Apart from their direct influence through "pester power", children also indirectly influence parents' food choices. Parents tend to select foods that match their children's preferences (Gram & Grønhoj, 2015; Hoffmann et al., 2018; Law et al., 2020). In this sense, unhealthy foods such as candies are frequently selected as treats to show love and warmth to children (Law et al., 2020; Petrunoff, Wilkenfeld, King, & Flood, 2014; Woloson, 2002).

Fig. 1 presents a schematic representation of a logic model for the influence of food packaging on children's diet, adapted from the models proposed by Grunert (2016) and Kelly et al. (2015). The logic model considers the sequence of effects that are necessary for the focal effect to

occur, in this case children's consumption (Barry, 1987). From a public health perspective, the final effect included in the model are the long-term health consequences of sustained food consumption patterns.

The brain has limited capacity for processing perceptual stimuli and relies on attentional mechanisms to select a subset of all the information it receives for further processing, suppressing processing of non-selected information (Milosavljevic and Cerf, 2008). Therefore, attention is the first necessary step that should be accomplished for consumers to purchase a product. A typical store can be regarded as an information-cluttered environment, as a vast number of products are available. In such context, a product's ability to capture attention at the point of purchase is a key factor influencing the likelihood that consumers would select that specific product (Atalay et al., 2012; Janiszewski et al., 2013). Research has shown that package design features, such as shape and contrast with the shelf, influence consumers' in-store visual attention (Clement et al., 2013; Clement et al., 2015).

Food package design also determines the subset of all the available information consumers attend to and consider in their decision-making process (Ares et al., 2013; Otterbring et al., 2013; Piqueras-Fizman et al., 2013; Rebollar et al., 2015). Attention to the information presented on the front-of-package (FOP) can be accidental due to automatic attentional processes that depend on the characteristics of packages (Grunert, 2016). However, the information included on the back-of-package requires top-down attentional processes, i.e., consumers need to be motivated to actively seek for the information by turning around packages (Pieters and Wedel, 2004). When assessing health and nutrition characteristics of a product, salient features in the FOP, like pictures, can be sometimes more important to define consumer perception than claims or nutritional information that are less salient or in the back-of-package, as only few consumers will flip packs to actively look for information (Varela et al., 2014; Machín et al., 2020).

The next step of the logic model is perception, i.e., awareness of the sensation created by packaging on the sensory receptors (Krishna, 2012). Once information is perceived, further processing can be achieved through two paths to determine purchase decisions (Fig. 1). According to the Associative-Propositional Evaluation model, perceptual inputs from food packages automatically trigger a series of associations that are part of associative networks, composed of elements connected by stable links as part of an associative store (Gawronski & Bodenhausen, 2007). These automatic associations elicit affective reactions and have the potential to influence children and parents' decision to purchase a product, as well as children's requests (Gawronski & Bodenhausen, 2007; Strack and Deutsch, 2004). Children's responses to food packages are expected to be mostly determined by automatic affective reactions, as previously reported for advertisements (Derbaix & Brée, 1997). In this sense, it is worth highlighting that children are the most vulnerable audience to the effects of food packaging given that

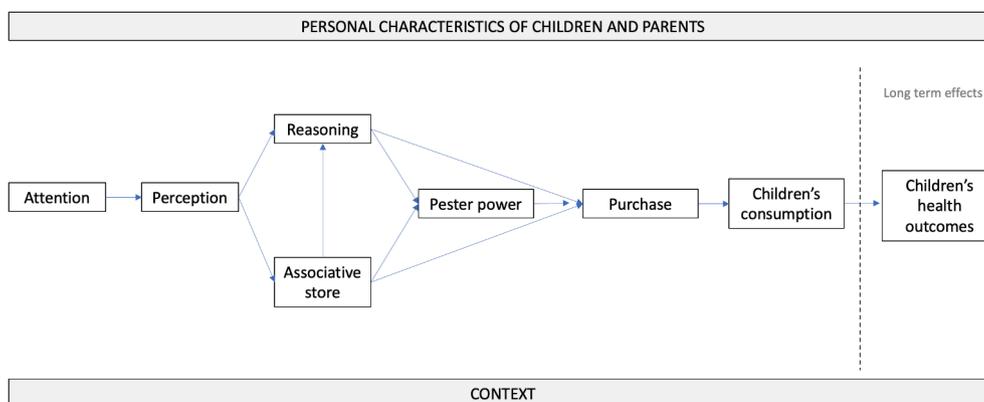


Fig. 1. Schematic representation of a logic model for the influence of food packaging on children's diet, adapted from the models proposed by Grunert (2016) and Kelly et al. (2015).

their food choices are mainly driven by pleasure (Nguyen et al. 2015; Marty et al., 2017; Pearce et al., 2020). In addition, children do not have the cognitive ability to detect the persuasive intent of food packaging (Lapierre et al., 2017). Children develop a marked change in how they perceive advertising when they reach early adolescence (John, 1999). Knowledge about the persuasive nature of advertising and skepticisms about its truthfulness is developed around the age of 8 (John, 1999; Lapierre et al., 2017). Younger children are particularly at risk of being misled by food advertising, and particularly food packaging (John, 1999).

The information from food packages is also rationally processed through the reflective system (Strack and Deutsch, 2004). Consumers analytically process the information from packages and make inferences about the information they convey, reaching decisions based on a trade-off between product characteristics (Grunert, 2016). However, people usually do not base their decision on an in-depth processing of all the available information; instead, they rely on heuristics, i.e., simplified decision-making strategies (Strack and Deutsch, 2004). For example, when making a choice between candies with different number of ingredients, small children (3–7 years old) tended to only attend to one type of information for making their choices (e.g., the number of ingredients) instead of all the available information (Wartella et al., 1979). Heuristics are expected to be particularly relevant for children's understanding of packages during perceptual stage (3–7 years old) or analytical stage (7–11 years old), when they rely on simple representations of objects based on perceptually salient features (John, 1999). With age, children develop more sophisticated information processing skills that allow them to analyze stimuli on multiple dimensions for making decisions (John, 1999).

Inferences about products are also influenced by the automatic associations raised by products (Strack and Deutsch, 2004). Consumers only invest a few seconds when making their decisions at the point of purchase, without engaging in a detailed analysis of all the information available on food packages (Machín, Curutchet, et al., 2020). For this reason, previous knowledge and the automatic associations raised by packages play a key role on shaping consumer inferences and subsequent purchase decisions about products (Strack and Deutsch, 2004). For example, the inclusion of the visual or textual references to fruits has been reported to raise health-related associations, regardless of the nutritional composition of the products (Devia et al., 2021; Nobrega et al., 2020; Sütterlin & Siegrist, 2015).

It should be noted that the contextual and personal characteristics from parents and children exert a strong effect on the sequence of effects presented in Fig. 1 and consequently define how packaging influences purchase decisions, children's diet, and long-term health outcomes (Kelly et al., 2015). A full description of the contextual and personal characteristics influencing consumer perception can be found in Köster (2009). In the following sections, the effect of two of the most relevant package features is discussed: child-oriented elements and health-related cues.

### 3. Packaging as the central strategy to target foods at children

Food products have been positioned as treats for children since the 19th century (Woloson, 2002). In the 1930s, the food industry recognized children as primary consumers and started marketing products directly at them (Cook, 2005). Since then, references to fun on packages have been the most central strategy to denote food products that belong almost exclusively to "children's world" (Elliott, 2015). The inclusion of visual and textual references to fun has been regarded as the key criterion for identifying products targeted at children (Chapman et al., 2006; Elliott, 2008; Elliott, 2019; Mehta et al., 2012; Giménez et al., 2017).

According to Elliott and Truman (2020), cartoon characters (including licensed cartoon characters, brand mascots and non-cartoon characters from TV or movies) are the most frequent marketing technique identified in products targeted at children. Children create

emotional bonds with the cartoon characters they are exposed to in their daily life, which encourages them to mimic their behavior (Lemish, 2007). For this reason, the inclusion of well-known cartoon characters is expected to create emotional associations, encouraging children to request the products to their parents or purchase them when they have their own money.

A broad body of evidence has shown that children prefer products with cartoon characters compared to those without characters (e.g., Ares et al., 2016; Lapierre et al., 2011; Letona, Chacon, Roberto, & Barnoya, 2014a; Levin and Levin, 2010; Roberto et al., 2010). In addition, the inclusion of cartoon characters on food labels has been reported to increase children's attention (Grendstad, 2020; Ogle, Graham, Lucas-Thompson, & Roberto, 2017). This effect has been reported to be particularly relevant for energy dense nutrient-poor foods, such as cookies and confectionary (Kraak and Story, 2015). According to parents' accounts, the presence of cartoon characters and toy tie-ins on the packages is a key trigger of children's requests at the supermarket (Campbell et al., 2014; Ford et al., 2020).

The effect of cartoon characters on perception and choice is expected to be influenced by their previous experiences. For this reason, familiar characters linked to TV programs, movies or games are expected to have a stronger influence than unfamiliar characters (Lemish, 2007; Arrúa, Curutchet et al., 2017; Velázquez et al., 2021). However, unfamiliar characters have also been reported to influence children's associations and perception (Enax et al., 2015). Arrúa, Vidal et al. (2017) reported that the inclusion of unknown cartoon characters (a green dinosaur on a strawberry yogurt label and a bear on a sponge cake label) raised associations related to fun. These associations may encourage children to prefer labels with unfamiliar characters over those without them, as reported by Ares et al. (2016) and De Droog, Valkenburg, and Buijzen (2011). The strength of the effect of unfamiliar characters has been reported to depend on their congruency with the product. According to De Droog, Buijzen & Valkenburg (2012) unfamiliar characters can be as effective as familiar characters if they are congruent with the product, from a conceptual point of view (e.g., a rabbit on a package of carrots) or perceptual point of view (e.g., an orange rhino on a package of carrots).

Nuances in the effect of different types of cartoon characters have been reported in the literature, even within familiar characters, which can be attributed to the mental associations raised by the characters. For example, Ogle et al. (2017) reported that SpongeBob SquarePants or Lightning MacQueen had a stronger effect than Dora the Explorer on the preference 6–7 year old boys. On the contrary, 6–7 year old girls were more likely to choose products with Dora the Explorer than products with the other two characters. This could be related to the gender-related associations of the characters. Similarly, Elliott (2009) reported age differences in children's perception of packages featuring cartoon characters. In this line, she reported that although 6–7 year old children were enthusiastic about the inclusion of characters from Toy Story on food packages, older children were negative about the inclusion of the characters as they regarded them as "too childish". Further evidence about the moderating effect of the associations raised by cartoon characters was provided by Arrúa, Curutchet et al. (2017). These authors reported that the inclusion of an unfamiliar monster with a sad face on the package of wafer cookies discouraged the choice of school-aged children, whereas the inclusion of a familiar character (a minion) on the package of orange juice increased choice likelihood.

The effect of cartoon characters on food preferences is expected to be larger for younger children, as their ability to differentiate cartoon characters from their real life increases with age (Valkenburg, 2004). According to Ares et al. (2016), the effect of cartoon characters on children's choice of yogurt and sponge cake labels was larger for 6–9 years old compared to 10–12 years old children. Interestingly, older children (9–11), when asked about healthiness, rated packs without cartoons healthier than those with cartoons (Grendstad, 2020). However, even if consciously rating them as less healthy, children still preferred packs with cartoons.

Cartoon characters are also expected to influence parents' perception and purchase decisions. However, studies on the topic are still scarce. Research has shown that the inclusion of cartoon characters on the packages reduces parents' healthiness perception (Abrams et al., 2015; Campbell et al., 2014; Contreras-Manzano et al., 2020). However, packages with characters are frequently regarded as more appealing for children (Abrams et al., 2015). In this sense, parents are expected to bend their own rules and to yield to their children requests' (Gram, 2015; O'Dougherty, Story, & Stang, 2006), as well as to select products with characters to fulfill pleasure-related goals (Law et al., 2020; Petrunoff et al., 2014). In a recent study, Velázquez et al. (2021) evaluated the effects of characters on the snacks mothers choose for their children using a choice experiment with sponge cake and chocolate-flavored milk labels. These authors reported that although cartoon characters did not have a significant effect on healthiness perception, they increased the purchase intention of 30% of the mothers.

Apart from cartoon characters, other packaging elements have been reported to influence associations and preferences. The inclusion of endorsements from sport celebrities on food packages increased perceived healthiness and quality, as well as choice likelihood and purchase intention of energy-dense and nutrient-poor products among children, adolescents, and parents (Dixon et al., 2010; Dixon et al., 2013; 2014). In addition, several studies have shown that colorful food packages, including textual and visual references to fun, are usually perceived as appealing by children (Letona, Chacon, Robert, & Barnoya, 2014b; Pires & Agante, 2011). Similarly, Lorestani and Khalili (2019) reported that the inclusion of references to games in food packages had a positive influence on children's and parents' purchase intention. Although other child-related cues, such as childish font, have been reported to frequently included on the packages of products targeted at children, research on their effect on perception and choice is still lacking (Elliott & Truman, 2020).

Based on the effect of cartoon characters on children's perception and preferences, scholars have proposed their use to promote consumption of packaged fruits and vegetables (De Droog et al., 2011; de Droog, Buijzen, & Valkenburg, 2012; Laureati et al., 2014; Lowe et al., 2004). In a recent study, Dial and Musher-Eizenman (2020) showed that 6–9 year old children rated fruits and vegetables in packages featuring cartoon characters as tastier than those in plain packaging or unpackage. In addition, the inclusion of cartoon characters on the packages increased children's willingness to taste the fruits and vegetables. This result may be explained considering that children associate packaged foods featuring cartoon characters with palatability due to their experience with packaged foods with high content of sugar, fat and sodium (Boyland and Halford, 2013). However, experimental evidence on the effects of cartoon characters on children's consumption of healthy foods is not conclusive yet. Studies have shown that the inclusion of cartoon characters can have a positive effect on children's evaluation of packages without influencing willingness to consume or to request the products from their parents (Hémar-Nicolas et al., 2021; Leonard et al., 2019).

#### 4. Food packaging as a source of health-related associations

Food companies frequently include a wide range of textual and visual cues on food packages to raise health-related associations, advertise products and set them apart from their competitors (Christoforou et al., 2018; van Bruul & Brouns, 2015). These cues include nutrition claims, which can be defined as "any representation which states, suggests or implies that a food has a particular nutritional property including but not limited to the energy value and to the content of protein, fat and carbohydrates, as well as the content of vitamins and minerals" (Codex Alimentarius, 2004). These claims are regulated in most countries to ensure that only substantiated claims are included (Hieke et al., 2016; van Buul & Brouns, 2015). In addition, nutrition marketing claims related to nutrient content (e.g., 'contains omega 6'), specific ingredients (e.g., pictures of

fruits and vegetables, 'whole grains' or 'no preservatives'), or production methods (e.g., 'vegan', 'traditional') are frequently included on food packages at the discretion of food manufacturers, regardless of the nutritional composition of the products (Christoforou et al., 2018; Schermel et al., 2013). Added to this, package design features (e.g., drawings, typography, colours) can also convey health related associations to parents and children (Ares et al., 2011; Carrillo et al., 2014; Hieke et al., 2015; Karnal et al., 2016; Letona et al., 2014b; Tijssen, Zandstra, de Graaf, & Jager, 2017).

Research conducted in different countries across the world has shown that health-related cues are highly prevalent in the food environment. Packages of products targeted at children frequently contain nutrition claims and other visual and textual elements to convey health-related associations (Elliott and Truman, 2020; Giménez et al., 2017; Mehta et al., 2012). According to Pomeranz et al. (2018), many of the claims related to health and nutrition included on the packages of toddler milk, formulas and milks in the US market are not based on scientific evidence. Misleading health-related cues are not only included on the packages of products targeted at children, but also in a wide-spread variety of products.

Packaging cues conveying health associations are expected to influence parents' decisions given that health-related goals are central when they choose foods for their children (Edvardsson et al., 2011; Maubach et al., 2009; Moore et al., 2010; Russell, Worsley, & Liem, 2015). Although parents tend to select products they regard as healthy, they often do not engage in an in-depth cognitive processing to make their healthiness judgements (Abrams et al., 2015; Maubach et al., 2009; Machín et al., 2016). Instead, they usually rely on heuristics (Abrams et al., 2015; Machín, Antúnez, et al., 2020). Parents have been reported to rely on simple health-related cues included on food packages to judge their healthiness, such as nutrition claims, images of fruits or endorsement logos (Abrams et al., 2015; Machín, Antúnez, et al., 2020).

Nutrition claims have been extensively reported to increase perceived healthiness (Lähteenmäki, 2013). Although these claims have the potential to help consumers to make healthier food choices, they are usually not correctly interpreted (Nocella & Kennedy, 2012). Parents have been shown to exhibit a tendency to overgeneralize claims (e.g., vitamin or mineral content claims), judging products as healthy regardless of their nutritional composition (Abrams et al., 2015; Harris et al., 2011; Machín et al., 2016). Such misinterpretation of nutrient claims may encourage them to select nutrient poor products for their children (Harris et al., 2011). In addition, other simple textual and visual elements on food packages, such as nutrition marketing claims and images of fruits and vegetables, also convey health-related associations and are regarded as indicators of product healthiness (Abrams et al., 2015; Machín, Antúnez, et al., 2020). For example, recent research has shown that including textual or visual references to fruits or vegetables, as well as references to 'home-made', increased perceived healthiness and purchase intention (Devia et al., 2021; Nobrega, Ares, and Deliza, 2020; Sütterlin and Siegrist, 2015).

Health-related cues do not only influence parents' healthiness perception and purchase decisions. Research has shown that such package elements also exert an influence on children. The inclusion of nutrient content claims has been reported to elicit health-related associations among children, encouraging them to prefer products with claims over those without claims (Ares et al., 2016; Arrúa, Curutchet et al., 2017; Dixon et al., 2013; 2014; Slaughter and Ting, 2010; Soldavini et al., 2012). According to Slaughter and Ting (2010), school-aged children prefer products with nutrient claims due to their frequent inclusion in packages and marketing campaigns, although they are not necessarily aware of the health-benefits of specific nutrients. In addition, Arrúa, Curutchet et al. (2017) reported that the inclusion of a strawberry image on the package of wafer cookies increased choice likelihood among school-aged children.

The effect of health-related cues on children's perception may be moderated by the perceived healthiness of the base product. Miller et al.

(2011) reported that the effect of claims on children's choice of breakfast cereal packages was stronger when they were included on unhealthy products. On the contrary, children tended to avoid (relatively) healthy products featuring claims due to the belief that healthy products are less tasty than unhealthy products.

## 5. Packaging as a tool to encourage healthy eating

Packages are increasingly used by policy makers to assist consumers in the identification of foods that are likely to be part of a healthy diet (Scarborough et al., 2007). In this sense, simple and graphical labels on the front-of-packages (FOP) are gaining increasing attention worldwide (Jones et al., 2019). FOP nutrition labelling describes labels included on the FOP that provide a simple summary of the nutritional composition of foods (Dean et al., 2015). Several FOP nutrition labelling schemes have been developed, which differ on how information about nutrient content is conveyed (Pan American Health Organization, 2020). Research has shown that schemes including interpretive aids (e.g., colors or textual information) are the most efficient at assisting consumers to judge product healthfulness and to differentiate between healthy and less healthy products (An et al., 2021; Temple, 2020).

Interpretive FOP nutrition labelling schemes were initially developed in the late 1980s by non-profit organizations as health logos to highlight healthy products (Dean et al., 2015). These schemes adopt a gain-frame approach to highlight food products with low content of nutrients associated with non-communicable diseases (NCDs). More recently, FOP nutrition labelling schemes were developed to highlight products with high content of nutrients associated with NCDs. This is the case of nutritional warnings, which highlight products with high nutrient content (Pan American Health Organization, 2020). Other schemes, such as NutriScore, and the Health Star Rating system, follow a hybrid approach and highlight both positive and negative aspects of the nutritional composition of products.

A large body of research has compared the efficacy of FOP nutrition labelling schemes (An et al., 2021; Temple, 2020). Although results are not consistent yet, emerging evidence suggests that nutritional warnings hold advantages over other schemes (Temple, 2020). Nutritional warnings have been reported to be more effective than the traffic light system or NutriScore at assisting consumers to identify products with unfavorable nutrient content and to discourage their choice under experimental conditions (Ares et al., 2018; Deliza et al., 2020; Khandpur et al., 2018). According to de Alcantara et al. (2020), loss-framed schemes, such as nutritional warnings, may be more efficient at encouraging consumers to select products with low sugar content than gain-framed schemes, such as health logos. This difference can be explained by the automatic associations raised by the schemes: nutritional warnings make the negative health consequences of excessive sugar consumption more salient in consumers' mind than health logos. By making the excessive content of nutrients more salient, nutritional warnings can encourage consumers to re-assess their purchase decisions, discouraging choice of products with excessive content of nutrients associated with NCDs (Ares et al., 2020). In this sense, nutritional warnings have been reported to be efficient at reducing positive emotional associations and discouraging choice of unhealthy products among children (Lima et al., 2019; Arrúa, Curutchet et al., 2017).

Highlighting products with low content of nutrients associated with NCDs can also generate negative sensory and hedonic expectations. Grendstad (2020) and Mikkelsen (2020) reported that school-aged children preferred packages of chocolate milk without the "no added sugar" claim. This suggests that the negative hedonic expectations generated by references to low content of nutrients associated with NCDs can override potential positive health associations, discouraging children's choice of healthier options. On the contrary, nutritional warnings have been shown to be effective at discouraging children's choice of packages of wafer cookies and juices with excessive content of fat and/or sugar (Arrúa, Curutchet et al., 2017).

Although, FOP nutrition labelling is part of a set of comprehensive policy actions recommended by the World Health Organization to promote healthier dietary habits and tackle obesity and non-communicable diseases (World Health Organization, 2017a; World Health Organization, 2017b), only a limited number of countries worldwide have implemented FOP nutrition labelling regulations (Jones et al., 2019). Most FOP nutrition labelling schemes currently implemented remain voluntary (Jones et al., 2019). Poor uptake of voluntary FOP nutrition regulations has been reported worldwide, which implies that consumers do not have FOP nutrition labels to guide their decisions for the majority of the products available in the marketplace (Kelly & Jewel, 2018). In this sense, voluntary implementation of the Health Star System has been shown not to achieve its objective of providing an overview of the nutritional composition of all food products as the food industry mainly includes the labels on the most healthy ones (3.5 stars or more out of 5) (Jones et al., 2018; Health Star Rating Advisory Committee, 2017). Therefore, mandatory FOP nutrition labelling regulations are needed to ensure the consistent uptake needed to enable consumers to make informed decisions.

Nutritional warnings are the most popular scheme among countries that have implemented mandatory FOP nutrition labelling regulations (Jones et al., 2019; Pan American Health Organization, 2020). Recent studies have shown that this scheme achieves its objectives after their implementation in Uruguay and Chile. Nutritional warnings have been reported to be effective at discouraging choice of products with excessive content of nutrients associated with NCDs, particularly among mothers of young children (Ares, Antúnez, & Curutchet et al., 2021; Correa et al., 2019). Interestingly, Correa et al. (2019) reported that children many times discouraged mothers from selecting products with warnings. The implementation of warnings in Chile has been associated with a reduction in sugar-sweetened beverages purchases (Taillie et al., 2020a; Taillie et al., 2020b), as well as a significant decrease in the content of sugar and sodium of several categories of food and beverages (Reyes et al., 2020).

## 6. The need for comprehensive packaging regulations

Changes in the food environment are necessary to guide children towards healthier diets (Hawkes et al., 2020). Policies are needed to create food environments that discourage consumption of foods with excessive content of nutrients associated with NCDs and create opportunities to easily achieve healthy diets (Downs et al., 2020). Marketing regulations are one of such policies (Raine et al., 2013). The importance of ending inappropriate promotion of unhealthy products for infants and young children has been widely acknowledged (World Health Organization, 2017a; World Health Organization, 2017b). However, restrictions of marketing to children via packaging are still uncommon worldwide (Taillie et al., 2019).

The power of marketing through packaging stresses the need to introduce comprehensive regulations that address the most prevalent elements included on the packages of products targeted at children. Table 1 summarizes the most relevant elements that should be considered for the design of packaging regulations aimed at encouraging healthier eating habits in childhood and beyond. Regulations should acknowledge that the role of food packaging on children's diet is not restricted to products specifically targeted at them. As discussed in the previous sections, health-related cues, which have been reported to have a strong influence on the perception and purchase decisions of parents and children, are highly prevalent in food packages in general. Therefore, focus on products directed to children may not be enough to protect them from misleading information included on the packages of foods with an excessive content of sugar, fat, and sodium. This suggests that packaging regulations should not be restricted to products targeted at children, but also to products targeted at the general public.

The top priority for packaging regulations aimed at protecting children from its deleterious effects should be to ban the inclusion of any

**Table 1**

Summary of the most relevant elements of food packaging that should be considered for the design of comprehensive packaging regulations to encourage healthier eating habits in childhood and beyond.

Packaging element	Effects on children and adults	Regulatory measure
Elements that attract children's attention (Cartoon characters, celebrity endorsements, game tie-ins, contests, childish font, references to fun)	Raise associations related to fun Influence preferences Increase choice likelihood	Prohibition on products with excessive content of nutrients associated with NCDs
Nutrition claims	Convey health-related associations Increase healthiness perception Increase choice likelihood	Prohibition on products with excessive content of nutrients associated with NCDs
Misleading health-related visual and textual cues	Convey health-related associations Increase healthiness perception Increase choice likelihood	Prohibition on any type of product
Interpretive front-of-package nutrition labelling	Modify the associations raised by food packages Increase ability to identify products with excessive content of nutrients associated with NCDs Increase ability to distinguish products according to their healthiness Discourage choice of products with excessive content of nutrients associated with non-communicable diseases	Mandatory inclusion on packaged products

packaging element to attract children's attention on the packages of products with excessive content of nutrients associated with NCDs (Elliott and Truman, 2020; Hawkes, 2010). In this sense, the European Consumer Organization (2017) has recently issued a call for food industries to stop using brand mascots and licensed media characters on the packages of foods high in fat, salt, and sugar.

So far, Chile and Mexico are the only countries with a comprehensive package regulation worldwide (Taillie et al., 2019; Secretaría de Economía, 2020). Chilean and Mexican regulation limits the use of marketing strategies aimed at attracting children, including licensed characters, brand mascots, movie tie-ins, child figures, contests, as well as premium offers, on products high in energy density, sodium, fat and sugar across all media, including packaging (Ministerio de Salud, 2017; Secretaría de Economía, 2020). Restriction of these marketing strategies to the packages of natural or minimally processed foods low in nutrients associated with NCDs could potentially contribute to increase their consumption among children, leading to an improvement of the quality of their diet (e.g., Dial and Musher-Eizenman, 2020). In addition, this regulatory approach could encourage the food industry to improve the nutritional composition of the products targeted at children, as it has been recently reported in Chile for breakfast cereals (Mediano Stoltze et al., 2019).

Although it has been widely acknowledged that the information included on food labels should not mislead consumers about the nature, properties, composition and production of food products (European Commission, 2014), misleading health-related cues have been reported to be frequent (BEUC, 2018). A large body of evidence suggests that the inclusion of nutrition and health claims on food packages increase healthiness perception and purchase intention of products with unfavorable nutritional composition (e.g., Ares et al., 2011; Ares et al., 2016; Arrúa et al., 2017; Carrillo et al., 2014; Hieke et al., 2015; Karnal et al.,

2016; Letona et al., 2014a; Nobrega et al., 2020; Tijssen, Zandstra, de Graaf, & Jager, 2017). Therefore, restrictions on the use of nutrient and health claims should be implemented based on the nutritional composition of products. Such claims should be banned in foods with excessive content of nutrients associated with NCDs, as currently done in Australia and New Zealand (Foods Standards Australia and New Zealand, 2016).

Furthermore, regulations should ban the inclusion of misleading health-related visual and textual cues as they increase healthiness perception and choice likelihood among both children and adults. In particular, images of healthy foods and references to home-made foods on the packages deserve special consideration, as they are powerful sources of health-related associations and hedonic expectations (Gil-Pérez et al., 2020). So far, most regulations do not include specific conditions for the inclusion of food images on the labels, except for a few categories (BEUC, 2018). In this sense, the US Academy of Nutrition and Dietetics urged the Food and Drug Administration to introduce specific requirements for the inclusion of images of healthy ingredients on the labels on products that only contain a small quantity of such ingredients (Academy of Nutrition and Dietetics, 2019). Similar restrictions are needed for other health-related cues, such as references to naturalness, home-made production, or traditional foods (BEUC, 2018). However, it should be highlighted that regulations on visual cues are not expected to be easy, as they are many times open to different interpretations.

Mandatory interpretive FOP nutrition labelling should be regarded as another key component of comprehensive package regulations to promote healthy eating among children. In particular, emerging evidence suggests that nutritional warnings seem to have advantages over other FOP nutrition labelling schemes. Warnings have the potential to shift the positive associations raised by food packages (Ares et al., 2020) and to discourage purchase and consumption of products with excessive content of nutrients (Ares, Antúnez, & Curutchet et al., 2021; Correa et al., 2019; Smith Taillie, Busey, Mediano Stoltze, & Dillman Carpenter, 2019). This scheme is gaining increasing relevance in the Americas: it has been compulsorily implemented in Chile, Peru, Uruguay and Mexico (Pan American Health Organization, 2020).

## 7. Challenges for the introduction of comprehensive packaging regulations

The introduction of comprehensive packaging regulations cannot be expected to be an easy task. Efforts by governments to introduce such regulations have faced fierce opposition globally, mainly in the form of opposition from the food industry and trade challenges (Ares, Antúnez, Cabrerar, & Thow, 2021; Dorlach & Mertenskötter, 2020; Julia & Hercberg, 2016; Mulligan et al., 2021; Vandenbrink et al., 2020). In particular, research has shown that the food industry engages in corporate political activity to promote deregulation (Ares, Antúnez, Cabrerar, & Thow, 2021; Julia & Hercberg, 2016; Mialon et al., 2020; Vandenbrink et al., 2020). The arguments of the food industry mainly rely on making consumers responsible for making healthy food choices and stressing the potential negative effect of the regulations in terms of costs required for implementation and their potential negative effects on sales (Ares, Antúnez, Cabrerar, & Thow, 2021; Mialon et al., 2020). Another major point of criticism is related to trade concerns, which have contributed to delays in the implementation of public health policies and even their watering down (Dorlach & Mertenskötter, 2020; Thow et al., 2017; Thow, Jones, Schneider, & Labonté, 2019; Thow et al., 2021).

Despite the challenges, international experience shows that it is possible to put forward comprehensive food packaging regulations to protect children from the deleterious effects of marketing. Development of acceptable and effective regulations require engagement of multi-sectoral stakeholders, including governmental stakeholders, international public health organizations, civil society and the academia (Campos & Reich, 2019; Kelly & Jewel, 2018; Villalobos Dintrans et al., 2020). Considering that packaging regulations are both health and trade policies, strategic engagement of economic policy actors early in the

process is recommended (Ares, Antúnez, & Curutchet et al., 2021). In addition, experience from Uruguay and Chile stress the importance of involving actors from all the political system to achieve effective and stable policies (Ares, Antúnez, & Curutchet et al., 2021; Villalobos Dintrans et al., 2020). Another key issue for the development of effective policies is reliance on a robust evidence-based approach (Head, 2010), as well as local formative research (Kelly & Jewell, 2019). In this sense, it is worth highlighting that further research is needed to evaluate the impact of packaging regulations on children and adults' eating habits. Empirical evidence about the real-life effectiveness of such regulations is expected to facilitate their adoption worldwide.

## 8. Conclusions

Food packages are one of the most important components of the marketing mix of food companies, being the central strategy to target products at children. Most of these products have poor nutritional quality and could compromise children's health. Food package design plays a key role in attracting children and parents' attention, shaping product associations, and influencing their purchase decisions. For this reason, comprehensive packaging regulations are necessary to protect children's health and encourage healthier eating habits. Such regulations should go beyond products targeted at children and include restrictions on the use of health-related cues on products targeted at the general consumers, as well as the inclusion FOP nutrition labelling. Although these comprehensive regulations may receive strong opposition from the food industry, they are already showing their efficacy in Latin American countries and can be particularly effective for creating a healthy child-centered food environment.

## Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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